

3

that represent the coverage area. However, since the maps are based on total received power, they are inaccurate to the extent that unwanted interference is present. Although post-processing may be able to remove some of the effects of unwanted interference in the measurement bandwidth, this requires an extra step, adding time and cost.

It should be noted that the above described problems exist in non-cellular CDMA communication systems as well, such as PCS or wireless local loop systems. What is needed is an accurate method for estimating the path loss and channel quality between a base station and a remote station in a CDMA communication system.

### SUMMARY OF THE INVENTION

In the present invention, the error in the estimate of the quality of the reverse link introduced by the presence of background interference is eliminated. The present invention is directed to a system and method for determining the power of a pilot signal included within a spread-spectrum signal received by a communications receiver, thereby enabling accurate estimation of channel quality and path loss. Within the communications receiver, a received signal power of the spread-spectrum signal is measured. A relative pilot strength measurement is also made of the pilot signal received with the spread-spectrum signal. The power of the pilot signal is then computed on the basis of the received signal power and the relative pilot strength measurement. In a preferred implementation, an indication of channel quality based on the pilot signal power is provided to a user of the communications receiver.

In another aspect, the present invention provides a system and method for estimating path loss of a communication channel between a base station and a remote site station. The base station transmits to the remote site station a pilot signal, and also transmits to the remote site station an indication of the power at which the pilot signal was transmitted. At the remote site station, a total received signal power over the CDMA bandwidth is measured and a relative pilot strength measurement is made of the received pilot signal. The power of the received pilot signal is then computed on the basis of the received signal power and the relative pilot strength measurement. An estimate of the path loss is then made by determining the difference between the indicated power of the transmitted pilot signal and the received pilot signal power.

By using the CDMA power of the pilot signal to estimate the quality of the reverse link, the present invention avoids the errors introduced by the presence of background interference in the CDMA bandwidth. The present invention, therefore, results in a significantly more accurate estimation of reverse link quality. Additionally, by directly determining path loss, rather than estimating it from the total received power, the present invention is also useful for network planning. A direct survey of path loss may be made from data logged by the mobile station, rather than requiring a post-processing of the total received power in order to generate a service area map.

### BRIEF DESCRIPTION OF THE DRAWINGS

Additional objects and features of the invention will be more readily apparent from the following detailed description and appended claims when taken in conjunction with the drawings, in which:

FIG. 1 illustratively represents a conventional cellular mobile telephone system;

FIG. 2 is block diagram of a mobile unit included within the mobile telephone system of FIG. 1;

4

FIG. 3 illustrates in further detail an analog receiver within the mobile unit of FIG. 2;

FIG. 4 is a detailed illustration of a digital receiver within the mobile unit;

FIG. 5 illustrates a selected portion of a demodulation element of the digital receiver; and

FIG. 6 is a flow chart representative of the manner in which received pilot power and path loss are determined in accordance with the present invention.

### DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

A conventional cellular mobile telephone system is illustrated in FIG. 1. The system illustrated in FIG. 1 utilizes CDMA modulation techniques in communications between the system mobile user and the cell-sites. Cellular systems in large cities may have hundreds of cell-site stations servicing hundreds of thousands of mobile telephones. The use of CDMA techniques readily facilitates increases in user capacity in systems of this size as compared to conventional FM modulation cellular systems.

In FIG. 1, a system controller and switch 10 typically includes appropriate interface and processing hardware for providing system control information to the cell-sites. Controller 10 controls the routing of telephone calls from the public switched telephone network (PSTN) to the appropriate cell-site for transmission to the appropriate mobile unit. Controller 10 also controls the routing of calls from the mobile units via at least one cell-site to the PSTN. Controller 10 may direct calls between mobile users via the appropriate cell-site stations since such mobile units do not typically communicate directly with one another.

Controller 10 may be coupled to the cell-sites by various means such as dedicated telephone lines, optical fiber links or by radio frequency communications. In FIG. 1, two exemplary mobile units 16 and 18 which include cellular telephones are illustrated. Arrows 20a-20b and 22a-22b respectively define the possible communication links between cell-site 12 and mobile units 16 and 18. Similarly, arrows 26a-26b respectively define the possible communication links between cell-site 14 and mobile units 18 and 16.

In the conventional CDMA system of FIG. 1, mobile unit 16 measures the total received power of all radio frequency (RF) energy in the frequency bandwidth of signals transmitted by cell-sites 12 and 14 upon forward link paths 20a and 26a. Similarly, mobile unit 18 measures the total received power of all radio frequency (RF) energy in the frequency bandwidth of signals transmitted by cell-sites 12 and 14 upon paths 22a and 24a. In each of mobile units 16 and 18, signal power is measured in the receiver while the signals are wideband signals. Accordingly, in a conventional CDMA system, this power measurement is made prior to correlation of the received signals with a pseudonoise (PN) spectrum spreading signal.

When mobile unit 16 is closer to cell-site 12, the received signal power should be dominated by the signal traveling path 20a. When mobile unit 16 is nearer to cell-site 14, the received power should be dominated by the signals traveling on path 26a. Similarly, when mobile unit 18 is closer to cell-site 14, the received power should be dominated by the signals on path 24a. When mobile unit 18 is closer to cell-site 12, the received power should be dominated by the signals traveling on path 22a.

In a conventional CDMA system, each of mobile units 16 and 18 uses the resultant measurement of total received